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RAPTOR RESEARCH is published quarterly in Spring, Summer, Fall, and Winter issues and occasional Supplements. The contents are usually divided into three sections. The first section is *SCIENTIFIC PAPERS* for reports of original research or theoretical analyses. These papers will be given careful editorial and referee scrutiny. A second section, *REPORTS, REVIEWS, AND OPINION,* will include secondary material, translations of material originally published elsewhere, reports of work still in progress, reports on meetings, often in some detail, book reviews, and other similar items. This material will be edited for accuracy but will not receive the critical review given the Scientific Papers. Because of the preliminary or secondary nature of the material in this section the Editors recommend that this material be cited in other papers only with great care or in a very general way and especially with specific preliminary or conference material only after consultation with the source of that information. Papers which express a personal opinion or letters to the Editor will be included in this section. *NOTES, NEWS, AND QUERIES* is used for notices of information or events, requests for information, news items either specially prepared or reprinted from other sources, and similar small items.

This journal began publication as RAPTOR RESEARCH NEWS with Volume 1 in 1967 as a quarterly in typewritten mimeographed form on an 8½" by 11" page size. Volumes 2 and 3 in 1968 and 1969 were offset printed but continued the same frequency, page size, and standard typewriter type. An analytical index for Volumes 1-3 was published. Volumes 4 and 5 in 1970 and 1971 were published six times a year in offset printing, 5½" by 8½" page size, and with IBM Composer typefaces; an analytical index for Volumes 4-5 is in preparation. In 1972, Volume 6, the name of the journal was changed to reflect the broader scope to RAPTOR RESEARCH. Currently the journal is published quarterly by offset printing with 6¾" by 9½" page size and IBM Composer typefaces and annual analytical indexes.

For membership and publication costs see inside back cover.

PREDATORY EFFICIENCY OF AMERICAN KESTRELS WINTERING IN NORTHWESTERN CALIFORNIA*

by
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ABSTRACT. A study of foraging behavior of the American Kestrel (*Falco sparverius*) wintering in Humboldt County, California was undertaken from October 1972 to February 1973. An analysis of predatory efficiency and prey selection is presented on the basis of numbers of species taken relative to the number of capture attempts, and the relative frequency with which they occur in the Kestrel's diet. A total of 498 capture attempts was observed; of these, 233 (46.8%) were successful, 221 (44.4%) were unsuccessful, and 44 (8.8%) were undetermined. Of the 233 successful captures 199 (85.4%) were invertebrates (beetles, grasshoppers, earthworms, butterflies and other insects) and 34 (14.6%) were vertebrates (mice, shrews and birds).

The American Kestrel (*Falco sparverius*) is one of the most common raptors in the New World, and has been the subject of many studies. Cade (1955) studied winter territoriality among Kestrels in southern California and suggested that territoriality serves to secure an adequate food supply through the winter. Roest (1957) described different aspects of breeding behavior, hunting methods and social interactions among Kestrels. Willoughby and Cade (1964) described the breeding behavior of captive Kestrels. Enderson (1960) reported on movements in a resident Kestrel population in east-central Illinois.

The lack of studies concerning prey selection and predatory efficiency among raptors, in general, and the American Kestrel, in particular, prompted this study of foraging behavior. Observations were made from October 1972 to February 1973 in the Arcata Bottoms east of Arcata, Humboldt County, California. The results reported here are part of a larger study to relate predatory efficiency, prey selection and activity budget, as observed in the field, to metabolic rates measured in the laboratory. The project is ongoing; more field data will be collected.

I am indebted to my advisor, J. R. Koplin, for his guidance and assistance throughout this study. I am also grateful to Howard Levenson and Larry Norris for censusing small mammals during the fall and winter months of 1972 and 1973.

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March 1973.

Study Area

The Arcata Bottoms consist of extensive pasture land used for grazing cattle. It is an ecological unit bordered on the south by Humboldt Bay, on the west by the Pacific Ocean, on the north by the Mad River, and on the east by the city of Arcata and the surrounding Redwood (*Sequoia sempervirens*) forests. Vegetation in the Arcata Bottoms consists predominantly of grasses, forbs, shrubs and few trees.

Materials and Methods

Observations of Kestrels were made during all daylight hours including as many full days as possible. Kestrels habitually used fence posts, power poles and power lines as perches; observations were readily obtainable. A spotting scope, binoculars and stop watch were used to observe and time the hunting activities of Kestrels under observation.

Rodent censuses in areas of hunting activities were made with use of Sherman live traps and the rate of capture technique (Davis 1963).

Prey Selection

Comparative analysis of the hunting efficiencies of male and female Kestrels was not possible because of the small number of males observed. The male to female ratio of Kestrels wintering in the Arcata Bottoms was one to nine (Koplin 1973). Observations of the males present were difficult to obtain; for this paper, data on both sexes were combined.

Observations were made on 24 American Kestrels, with intensive observations on six. Dives which resulted in the capture of prey or which resulted in landing on the ground were considered "completed dives."

Over the five-month period, 498 completed dives were recorded; of these, 233 were successful. Identification of food items showed that 34 were vertebrates and 199 were invertebrates. The relative frequency of each is shown in Table 1. Identifiable invertebrates included five grasshoppers, nine beetles, nine earthworms, and two butterflies. Identifiable vertebrates included six California Meadow Voles (*Microtus californicus*), three Western Harvest Mice (*Reithrodontomys megalotis*), and 18 Vagrant Shrews (*Sorex vagrans*). Two small birds and five small mammals could not be identified.

Considered on a seasonal basis, the data show that the number of invertebrate prey decreased and the number of vertebrate prey increased during the winter (Figure 1). The capture of vertebrates reached a peak during December, the coldest month in Humboldt County history. In subsequent months, the frequency of invertebrates taken increased with a corresponding decrease in the number of vertebrates taken.

Censuses of insect populations were not conducted. No quantitative evidence exists to determine whether the Kestrels selected rodents and shrews in preference to available insects, or fed primarily on rodents and shrews in the absence of insects. However, during December, unusually large numbers of Killdeer (*Charadrius vociferus*) moved into the study area from the north and from the

Table 1. Prey species captures by American Kestrels wintering in Humboldt County, California.

Prey Species	Number Captured	Percent of 233 Prey Captured
Invertebrates		
grasshoppers	5	2.2
beetles	9	3.9
earthworms	9	3.9
butterflies	2	0.9
unidentified insects	174	74.7
total invertebrates	199	85.6
Vertebrates		
Microtus	6	2.6
Reithrodontomys	3	1.3
Sorex	18	7.7
unidentified mammals	5	2.2
small birds	2	0.9
total vertebrates	34	14.7
Total Prey Captured	233	99.3

surrounding foothills. A great many of these terrestrial insect-eating birds subsequently starved to death. This was one indication that Kestrels were feeding primarily on rodents and shrews in the absence of insects.

An attempt was made to assess variation in the availability of rodents and shrews. Because of the small numbers captured by Kestrels and the lack of population estimates from trapping data, small birds and Western Harvest Mice were not included in the analyses. Through the fall and winter months, estimates of prey densities were obtained in two areas where Kestrels commonly hunted. During the census periods, there was no significant difference between the two areas in the relative numbers of prey species trapped (X^2=0.72; p=0.25-0.50, 1 d.f.).

There was a decline in prey densities in excess of 50 percent between the fall and winter censuses. However, in each area the difference between the relative number of prey species trapped in the winter, and in the fall, was not statistically significant (X^2=3.19; p=0.10-0.05, 1 d.f.).

Thus, it was possible to combine the data from both areas for estimates of densities of *Microtus* and *Sorex* populations. A Chi-square test was made of the

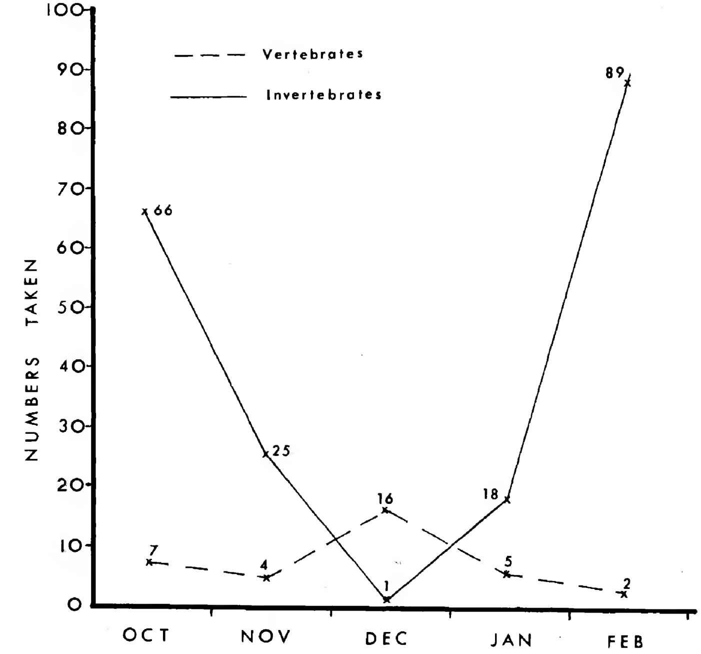

Figure 1. Numbers of vertebrates and invertebrates captured monthly by wintering American Kestrels.

relative frequency of *Microtus* and *Sorex* captured by the Kestrels, and the relative numbers trapped. This test was made to determine if selection for a particular prey species was occurring. The Kestrels captured *Microtus* and *Sorex* in the same relative proportions as trapped (X^2=1.18; p=0.025-0.500, 1 d.f.). This indicates no measurable selection for either of the two major vertebrate prey species.

A final comparison was made between the fall and winter rodent and shrew densities, and the fall and winter rodent and shrew captures by the Kestrels. The increase in the incidence of captures in the winter and the measured decreases in the densities were significantly different (X^2=9.28; p=0.005, 1 d.f.). This supports the postulate that Kestrels exploited the rodent and shrew populations in the absence of insect prey.

Hunting Efficiency

I observed 498 capture attempts; of these, 233 (47 percent) were successful, 221 (44 percent) were unsuccessful and 44 (9 percent) were undetermined (Figure 2). The inability to assess the success of a dive resulted from a Kestrel diving into a gulley, behind a bush or behind other visual obstructions. Eliminating such observations, the Kestrels captured prey during 51 percent of their capture attempts.

Kestrels most commonly hunted from a perch; however, they also hovered while hunting. Of 95 completed dives from a hovering position, 22 (i.e. 23 percent) were successful, 69 (73 percent) were unsuccessful, and 4 (4 percent) were undetermined. Of the 403 completed dives from a perch, 211 (52 percent) were successful, 152 (38 percent) were unsuccessful and 40 (10 percent) were undetermined. These data demonstrate that hunting from a perch was a more

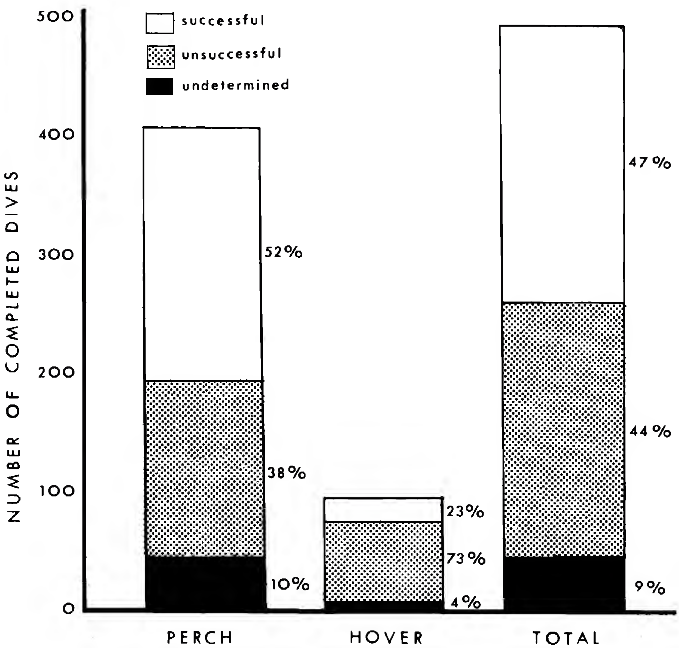

Figure 2. The success of hunting methods used by wintering American Kestrels.

efficient means of capturing prey.

I attempted to differentiate vertebrate hunting attempts from invertebrate hunting attempts. This separation was based on observed differences in hunting methods. Fast, flex-gliding dives were classified as "vertebrate dives", and soft, fluttering dives were classified as "invertebrate dives." Of those dives in which the success was determined, 36 of 145 (25 percent) of the "vertebrate dives" were successful, while 198 of 309 (64 percent) of the "invertebrate dives" were successful. These results reflect the greater mobility of the rodent and shrew prey. Considering the diverse diet of the Kestrel, the possible existence of prey-specific hunting behavior should be investigated. The evolution of specialized hunting methods might be a contributing factor in the widespread success of this species.

Discussion

Several recent studies provide additional information on the hunting success of Kestrels. In Costa Rica, Jenkins (1970) recorded a hunting efficiency of 39 percent by a male Kestrel. Sparrowe (1972) observed 54 capture attempts by 20 Kestrels in Michigan; of these, 33 percent were successful. The differences in predatory efficiency between these studies and mine could be attributed to small sample size. However, these differences could also reflect differences in habitats, or differences in availability of prey species, or a combination of both.

Rudebeck (1951) recorded an over-all hunting efficiency of eight percent among migrating European Sparrow Hawks (*Accipiter nisus*), Peregrine Falcons (*Falco peregrinus*), Merlins (*F. columbarius*) and White-tailed Sea Eagles (*Haliaeetus albicilla*). This is considerably lower than the 51 percent hunting success recorded among American Kestrels wintering in the Arcata Bottoms, indicating the advantage of maintaining a territory. Increased hunting efficiency could result from familiarity of winter residents with locations of available food resources. Future observations on hunting efficiency of migrating Kestrels in the Arcata Bottoms should indicate whether or not this is the case.

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FORAGING BEHAVIOR OF OSPREYS IN NORTHWESTERN CALIFORNIA*

by
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ABSTRACT. Fishing success of Ospreys (*Pandion haliaetus*) at South Humboldt Bay, California, was determined during spring and summer, 1972. Five hundred twenty-three of the 639 observed fishing efforts (82 percent) were successful. Fifty-six percent of the fishing efforts required only one dive. The mean length of time spent foraging for each successful fishing effort was 11.8 minutes. The highest fishing success occurred during the fledging period, and lowest during incubation, 86 and 79 percent, respectively. Successful fishing efforts were highest on the outgoing tide early in the breeding season. Fishing success on outgoing tides decreased as the season progressed, and increased (59 percent) on the incoming tide. Successful fishing efforts were the same (43 percent) on both incoming and outgoing tides during the brooding period.

Skill and swiftness in capturing prey animals are survival requisites for avian predators occupying terminal positions of food chains. The present study was made to determine the success of Ospreys in securing fish during the breeding season.

The feeding habits of Ospreys were virtually unknown until fairly recently. Lambert (1943) observed Osprey strikes and found their efficiency to be 89 percent. His observations did not take into account the number of dives required per individual Osprey to capture prey. However, as a result of more recent studies, we have a better understanding of the fishing success of Ospreys in different areas of the western United States.

Over a three-year period, MacCarter (1972) found Ospreys at Flathead Lake, Montana, to be 83 percent successful in 158 fishing efforts. At Eagle Lake, Lassen County, California, Garber (1972) found that Ospreys were 80 percent successful in 25 fishing efforts. Ospreys fishing the surf at Usal Creek, northern Mendocino County, California, were 86 percent successful in 116 fishing efforts (French 1972).

Sixty-three percent of fishing efforts at Flathead Lake resulted in capture of prey on the first dive. At Eagle Lake and Usal Creek, successful fishing efforts on the first dive were 52 and 67 percent, respectively.

The foraging behavior of Ospreys at South Humboldt Bay, California was de-

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March 1973.

termined during spring and summer, 1972. This is a preliminary report of an ongoing study and is based on more than 600 observed fishing efforts.

We are grateful to Jon French, Craig Bradshaw, David LaConte and Paul Colbert, present and former students at California State University, Humboldt, who assisted in field observations.

Study Area

Humboldt Bay is located on the coastal region of Humboldt County, California, approximately 435 kilometers (270 miles) north of San Francisco. It is 22.5 kilometers (14 miles) long and from 0.8 to 6.4 kilometers (0.5 to 4.0 miles) wide, and lies in a southwesterly to northeasterly direction. Being connected to the ocean, it is subject to tidal changes.

The surface area of Humboldt Bay fluctuates from 62.7 sq. kilometers (24.2 sq. miles) at mean high tide to 33.2 sq. kilometers (12.8 sq. miles) at mean low tide. The Bay is composed of three different parts with respect to fluctuating surface areas. South Bay has 18.4 sq. kilometers (7.1 sq. miles) of surface area at mean high tide, and 7.8 sq. kilometers (3.0 sq. miles) at mean low tide; Entrance Bay has 7.5 sq. kilometers (2.9 sq. miles) at both tides; and North Bay has 36.8 sq. kilometers (14.2 sq. miles) at mean high tide, and 17.9 sq. kilometers (6.9 sq. miles) at mean low tide (Skeesick 1963).

Preliminary observations at Humboldt Bay revealed that Ospreys were primarily fishing South Bay. Therefore, observations were restricted to the southern portion of Humboldt Bay.

Methods

A 20x spotting scope, binoculars and stopwatch were used to obtain information on the fishing activities of Ospreys. Fishing success was measured by recording the total number of fishing efforts–total dives made by one Osprey while under observation. Measurements of predatory efficiency were obtained by recording the total number of dives per fishing effort resulting in capture of prey.

Each fishing effort was timed from the moment an Osprey first was sighted until it either captured fish, or was lost to view.

Observations were made from dawn to dusk for two days each week from a vantage point where a major portion of South Bay could be viewed. Tide conditions were noted during each day of observations.

Fishing Success and Predatory Efficiency

A total of 639 fishing efforts was observed at South Humboldt Bay (Table 1). Fifty-six percent of fishing efforts resulted in capture of prey on the first dive. However, on one occasion an Osprey required 13 dives to capture a fish.

Over-all, Ospreys were 82 percent successful in their fishing efforts. Of the 116 unsuccessful fishing efforts (18 percent), only 21 (3 percent) involved Ospreys that flew inland without securing fish. The remaining 95 (15 percent) unsuccessful fishing efforts involved birds lost to view.

Table 1. Relative fishing success of Ospreys fishing South Humboldt Bay, Usal Creek, Eagle Lake, California; and Flathead Lake, Montana. Modified from Koplin *et al.* (in press).

No. of dives per successful fishing effort	S. Humboldt Bay (% of 639 fishing efforts)	Usal Creek (% of 116 fishing efforts)	Eagle Lake (% of 25 fishing efforts)	Flathead Lake (% of 158 fishing efforts)
1	56	67	52	63
2	18	15	16	12
3	6	3	8	7
4	1	1	4	1
5	0.6	–	–	–
6	0.2	–	–	–
13	0.2	–	–	–
Total % Successful fishing efforts	82	86	80	83

The 639 fishing efforts were stratified into five phases of the breeding cycle: pre-incubation, incubation, brooding, fledging and post-fledging (Figure 1). This was done to determine whether fishing success of Ospreys changed through the breeding season. At Nova Scotia, Lambert (1943) found a decrease in the capture of fish from May through August. Fishing success varied through the season at South Bay. The highest success was during the fledging period and the lowest during incubation, 86 and 79 percent, respectively.

Time Spent Foraging

Mean length of time spent foraging from first sighting until the capture of prey for the 523 successful fishing efforts was 11.8 minutes. However, in terms of different phases of the breeding season, it appears as if average foraging time was inversely related to food demand (Figure 2). That is, as the demand for fish by the growing young increased, average foraging time decreased. Consequently, when demand was highest during brooding, average foraging time was lowest. When young began fledging and a continuous supply of fish was no longer essential, average foraging time again increased through the late fledging and post-fledging periods.

Effects of Tidal Change

Fishing success was highest (59 percent) on the outgoing tide early in the breeding season. Success in relation to season declined on the outgoing tide and increased on the incoming tide (Figure 3). Successful fishing efforts were the

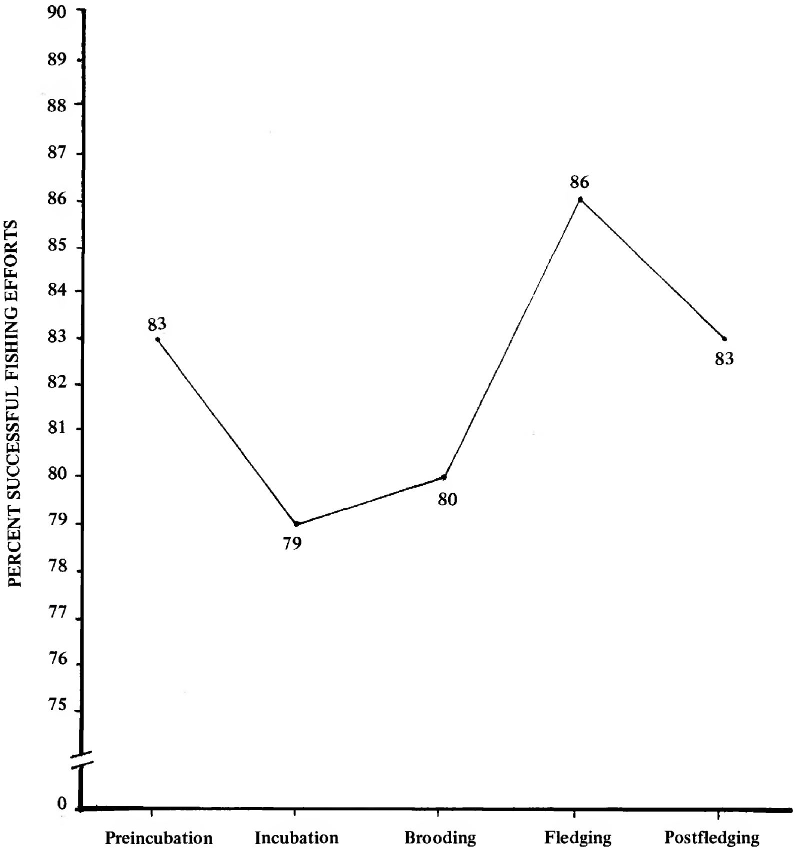

Figure 1. Successful fishing efforts for each period of the breeding season.

same (43 percent) on both incoming and outgoing tides during the brooding period. We are at a loss to explain these findings, but suspect differential movements of fish in and out of the Bay on a seasonal basis.

Prey Species

Sixty-three percent of the fish taken by Ospreys were surfperch (Embiotoci-

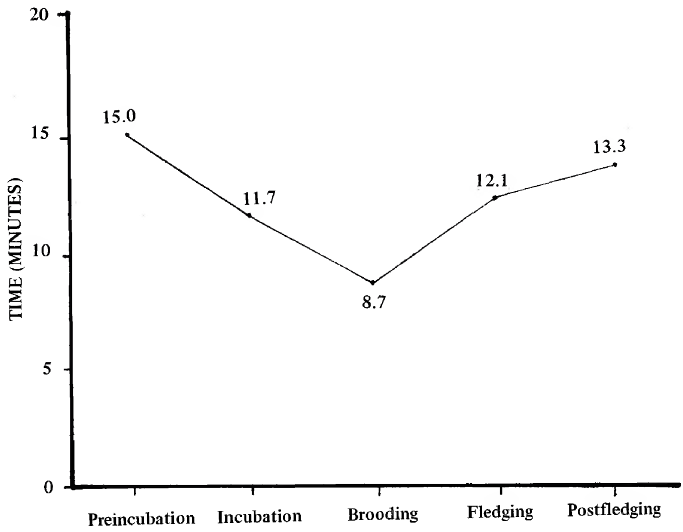

Figure 2. Mean length of time spent foraging for successful fishing efforts for each period of the breeding season.

dae). Of the fish caught, three percent were anchovies (Engraulidae), two percent silversides (Atherinidae), two percent herrings (Clupidae), one percent sculpins (Cottidae), and 29 percent were unidentifiable. In addition, the remains of nine surfperch, two silversides and one sculpin were found beneath a perch used by Ospreys for feeding at South Bay.

The lengths of 211 fish caught by Ospreys were estimated to be 18 to 23 cm (7-9 inches). Seven fish were less than 10 cm (4 inches) long, and only one was greater than 38 cm (15 inches) long.

Discussion

Mech (1966) stated that predators miss far more prey than they catch. However, as indicated in this and other studies, Ospreys are an exception. They are successful predators.

Ospreys are capable of capturing two fish, one in each foot, on a single dive as observed by French (1972) at Usal Creek. One of us (M. L. U.) also witnessed a double catch at Usal Creek.

On several occasions, when Ospreys dropped the fish they were carrying, they quickly secured a second. Ospreys were seen to consume a small fish com-

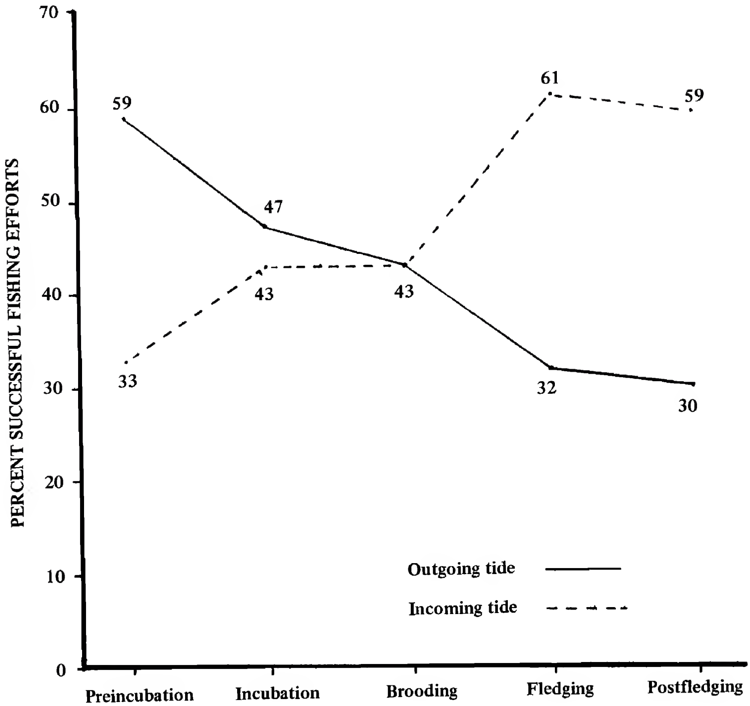

Figure 3. Successful fishing efforts for each period of the breeding season in relation to the tide cycle.

pletely and begin fishing again, capturing a second, often larger fish before heading inland to the nest site.

As indicated by the average time spent foraging and the number of successful fishing efforts requiring one dive, Ospreys have little difficulty in locating and capturing prey. When only the 523 successful fishing efforts are considered 69 percent were successful on the first dive; 523 of the 834 total dives (62 percent) resulted in capture of fish, indicating that Ospreys catch fish more often than they miss.

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DIFFERENTIAL HABITAT USE BY SEXES OF AMERICAN KESTRELS WINTERING IN NORTHERN CALIFORNIA*

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ABSTRACT. Differential habitat use by sexes of American Kestrels (*Falco sparverius*) wintering in Humboldt, Mendocino, Lake, Colusa and Yolo Counties, California, was discovered and quantified by roadside counts conducted during the winters of 1970-71 through 1972-73. A prevalence of females was discovered in expansive pastures and fields devoid of or with few trees, and a prevalence of males was discovered in orchards and small pastures and fields surrounded by trees. However, Chi-square tests of homogeneity and frequency indicated a complex transition in habitat use. Relative abundance of Kestrels, measured by linear distance between 340 successive observations, differed significantly only between the Central Valley and the other areas sampled. Kestrels averaged 115 individuals per 100 miles (161 km; 135 observations) in the Central Valley and 34 birds per 100 miles (161 km; 205 observations) elsewhere. The differential use of habitats by wintering Kestrels is interpreted as character displacement. Its relevance to the principle of competitive exclusion is discussed.

Population studies of raptors wintering in the Arcata Bottoms near Arcata, Humboldt County, California, in the fall of 1970 revealed an unexpectedly high proportion of female Kestrels (*Falco sparverius*) in censuses. Six to twenty times as many females as males were counted through the winter. Roadside counts of Kestrels wintering in other areas in coastal Humboldt County also revealed high numbers of females. Since these findings were contrary to those reported by Roest (1957), who found that males constituted approximately 60% of late summer, fall and winter populations of Kestrels over a wide geographic area in the United States, I extended the study to include other geographic areas in northern California.

Methods

I conducted roadside counts of Kestrels between late November and mid-February in Humboldt, Mendocino, Lake, Colusa and Yolo Counties. Habitats censused included open areas relatively devoid of trees, areas vegetated predominantly by trees, and areas transitional between these two major habitats.

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March 1973.

Open habitats included pastures in the vicinity of Humboldt Bay and agricultural fields in the Central Valley. Wooded areas censused were in the Coast Range. Transitional habitats censused were immediately east of Humboldt Bay and riparian habitats along the Sacramento River in the Central Valley.

Kestrels were observed mainly in agricultural areas in the Coast Range. So few were observed in redwood (*Sequoia sempervirens*) and Douglas fir (*Pseudotsuga menziesii*) forests on the west slope and in pine-oak-chapparal woodlands on the east slope that they were not counted in these habitats. Thus, surveys in the Coast Range were restricted to agricultural areas along the Mad, Elk, Van Duzen, Eel and Mattole Rivers, and Jacoby and Salmon Creeks on the west slope; and to agricultural areas along Cache Creek and Clear Lake on the east slope.

Each Kestrel observed was examined carefully with the aid of 10-power binoculars or a 15-power spotting scope to determine its sex. Only those birds in which sex was positively identified were recorded. Attempts to age Kestrels in the field were unsuccessful.

Distance between successive observations of 340 birds was recorded to the nearest 0.1 mile (0.16 km) on automobile odometers as a means of measuring density.

Results and Discussion

A total of 670 Kestrels was sexed in all habitats surveyed during the winters 1970-71 through 1972-73 (Table 1). Chi-square tests of homogeneity and fre-

Table 1. Sex ratios of Kestrels wintering in open, wooded, and transitional habitats in northern California.

Geographic area and habitat	No. females	No. males	Sex ratios* females:males
Coastal Humboldt County			
open pasturelands	151	16	9.4:1[a]
transitional habitats	192	55	3.5:1[b]
Central Valley			
open farmlands	73	19	3.8:1[b]
transitional habitats	26	21	1.2:1[c]**
Coast Range			
wooded pastures and orchards	35	85	1:2.3[d]

*Ratios followed by different letters are significantly different from each other ($p \leq 0.05$); ratios followed by the same letter are insignificantly different from each other ($p = 0.75$).

**Insignificantly different from a 1:1 sex ratio ($0.75 < p < 0.50$); all others are significantly different from a 1:1 sex ratio ($p \leq 0.05$).

quency indicated significant differences in sex ratios among Kestrels in pastures on the coast, riparian habitats in the Central Valley, and wooded habitats in the Coast Range. Sex ratios in transitional habitats on the coast and in agricultural fields in the Central Valley were statistically similar, but differed significantly from the other three habitat types.

The null hypothesis that sex ratios were 1:1 was rejected for all but Kestrels in riparian habitat in the Central Valley.

Analysis of variance of distance between successive observations showed only two differences: average densities of 34 Kestrels per 100 miles (161 km; 95% confidence estimate of mean = 34 ± 11 Kestrels per 100 miles–161 km) in coastal and Coast Range habitats, and 115 Kestrels per 100 miles (161 km; 95% confidence estimate of mean = 115 ± 25 Kestrels per 100 miles–161 km) in Central Valley habitats. This indicated a difference in relative suitability of these areas for Kestrels, including differences in suitability of coast transitional and Central Valley open habitats in which there was no significant difference in sex ratios.

These results clearly indicate habitat segregation between sexes of Kestrels wintering in northern California. Males predominate in wooded, agricultural habitats and females predominate in open pastures and fields. The open and transitional habitats differed latitudinally as well as climatically. Therefore, it is not possible to interpret the decrease in the relative proportion of females in open and semi-wooded habitats between coastal Humboldt County and the Central Valley. More extensive surveys are required to determine if sexes of Kestrels are segregated latitudinally (i.e., geographically) as well as on the basis of habitat.

Habitat segregation by sexes of wintering Kestrels is interpreted here as character displacement (Brown and Wilson 1956) reducing intersexual competition for food resources. Habitat segregation by sexes is but one of several methods by which intersexual competition for food may be alleviated. In his general review of the phenomenon, Selander (1966) discussed several alternatives including one other that has been documented for Falconiformes: the selection of prey differing in size by sexes of accipiters (Höglund 1964, Storer 1966) and Peregrine Falcons (*Falco peregrinus*) (Cade 1960). Accipiters and Peregrine Falcons exhibit pronounced sexual dimorphism in body size; the size of prey selected by these birds is directly proportional to their own body size. Presumably, Kestrels also fit this pattern. However, even though the sexes of Kestrels differ in body size, they are much less dimorphic than are the sexes of accipiters and Peregrine Falcons (Selander 1966:139). Therefore, the sexes of the relatively monomorphic Kestrels would be expected to select prey of similar size in different habitats, whereas sexes of the more dimorphic accipiters and Peregrine Falcon would be expected to select prey of different sizes in the same habitat. In support of this postulate, Cade (1960:243) reported that he has unpublished data indicating that sexes of Kestrels select prey of similar size and Collopy (pers. comm.) reports no evidence of differential size selection of prey by sexes

of Kestrels. Thus, habitat segregation of Kestrels by sexes may be an adaptation necessary to alleviate intersexual competition for food.

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POST-FLEDGING ACTIVITY OF THE RED-TAILED HAWK*

by
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ABSTRACT. During a two-year study of post-fledging activity of Red-tailed Hawks (*Buteo jamaicensis*) in the Gallatin Valley, Montana, in 1971 and 1972, data were collected on mortality, length of time the fledglings remain within the home territory, and characteristics of their movements out from, and possibly, back to their home territory. Mortality was found to be low during the first 18-25 days after fledging, when the young were quite inactive. Mortality also may be low until the young begin leaving the home territory. The length of time the young remained associated with the adults ranged from 30 to 70 days after fledging for all fledglings observed. For nest-mates, time spans between departures ranged from zero to 31 days after fledging. Movements of the fledglings out from and back to the home territory were variable. Some young made no movements out from the home territory until they left permanently, while others left and returned up to five times. The length of time the young remained associated with the adults, and thus within the home territory, did not determine the number of movements it made into the areas surrounding the home territory, before it left it permanently.

A study was conducted during the summers of 1971 and 1972 on the post-fledging activities of Red-tailed Hawks (*Buteo jamaicensis*). The study area was located in the Gallatin Valley, Gallatin County, in southwestern Montana. The objectives of the study were to gather information on mortality, length of time the fledglings remained within the adult territory, their movements both within and outside of the adult territory, and the development of hunting and social behaviors. In this paper hunting and social behavior are not considered.

Methods

The study area included approximately 145 sq. km (56 sq. miles) and, during each summer, contained a maximum of 18 pairs of nesting Red-tailed Hawks. In 1971, eight successful nests were observed soon after the young fledged, but after they became more active, fledglings from only three nests were observed. All young were color-marked for identification. In 1972, eight nests were observed from the time the young fledged until they could no longer be located.

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March 1973.

All young were color-marked and nine were radio-tagged.

Color-marking involved spraying the undersides of the wings and tail with non-toxic spray paint. The transmitters, purchased from the AVM Instrument Company and weighing approximately 20 g, were attached to the fledglings by a harness. Life of the transmitters was approximately three months. The harness was attached with dissolvable gut-suture, which would in time wear away and cause the transmitter to fall off the bird. These transmitters were placed on nine fledglings from seven nests at seven to eight weeks of age. All of the radio-tagged young were then located three times daily during the first and second day of a three-day cycle; just the young from a single nest were observed throughout the third day.

Mortality

Results on mortality of fledglings from the time they left the nest until they could no longer be located are given in Table 1. After the young fledged, they remained within a limited area, a post-nesting area, until from 18 to 25 days

Table 1. Length of time fledglings observed after fledging when no mortality occurred.

Nest	Year observed	Time spent in post-nesting area	Number of young in the nest	Days AF[1] when all nestmates known alive
61	1972	18	4	41
7	1971	25	3	54
34	1971		3	33
7	1972	25	3	32
34	1972	23	3	47
11	1971	24	2	33
9	1972	17	2	31
11	1972	21	2	42
33	1972		2	34
62	1972	20	2	39
8	1972	18	2	18[2]
24	1971	23	3	23[2]
25	1971	18	2	26[2]
26	1971	22	3	27[2]
15	1971		3	25[2]
36	1971		2	23

[1]days after fledging.

[2]Observations were discontinued at that age due to difficulty in locating the fledglings.

after fledging as measured from 13 nests during the two-year study. During this post-nesting period, the young attempted no hunting, remaining completely dependent upon the adults for food. The tendency of the adults to bring food less and less often as the post-nesting period progressed, and the increased development of the young, were probably two important factors causing the young to leave the post-nesting area and to move out where the adults were hunting. A total of 41 young from 16 nests were observed at least up to the end of the post-nesting period. During this time no mortality was observed. The earliest age when observations were discontinued on young from a nest was 18 days after fledging; thus, no mortality was observed for 41 young up to 18 days after fledging. Of 10 nests containing 26 young (all observed throughout the summer until the young could no longer be located), the latest date that all young were observed, and thus known to be alive, was 31 days after fledging. For these 26 young, no mortality had occurred at least through the first 31 days after fledging. The average age of these 26 young when last observed was 43 days after fledging. For fledgling Red-tailed Hawks in the Gallatin Valley it appears that mortality is very low for the first 17 to 25 days after fledging, during the post-nesting period, and, possibly, mortality is low until the young begin leaving the home territory.

Length of Time Young Remain Home

The ages in days after fledging when the 26 fledglings from the 10 nests which were observed until the fledglings could no longer be located, are given in Table 2. As only nine of the 26 young were radio-tagged, the reason for the

Table 2. Age after fledging when fledglings last observed in the home territory.

Nest	Year Observed	Number of young in nest	Days after fledging fledglings last observed			
			1st	2nd	3rd	4th
61	1972	4	39[r]	41	42	70[r]
34	1971	3	31	42	42	
7	1971	3	53	53	53	
7	1972	3	30[r]	37	61[r]	
34	1972	3	46	46	51[r]	
11	1971	2	33	47		
9	1972	2	31[r]	31*		
11	1972	2	42[r]	43*		
33	1972	2	34[r]	35*		
62	1972	2	38	51[r]		

[r]Fledgling was radio-tagged.
*Fledgling was not checked after that age.

disappearance of the remaining 17 young from the home territory was not known. This may have been due to their death or their leaving the home territories. The ages of disappearance fell within the age range at which radio-tagged young left, which was from 30 to 70 days after fledging. The age at which the first nestmate from a nest left the home territory permanently ranged from 30 to 53 days after fledging. The first day that all nestmates from one nest were permanently gone from the home territory ranged from 47 to 70 days. Concerning the permanent departure of nestmates, only two nests contained more than one radio-tagged young, enabling a definite determination of the age both nestmates left the home territory. For these nests, time spans between departures of nestmates were 31 days in both cases. When the ages of permanent departure of all 26 young are considered, there appears to be no pattern for departure of nestmates. In three nests in which a single radio-tagged young left first, the nestmates were not further observed. In the remaining seven nests, departure of nestmates was staggered (at least five days between departures) for three nests containing two, two, and three young. It was simultaneous (leaving on the same day or within several days later) for one nest containing three young. In the remaining three nests, containing three, three, and four young, departures of nestmates were both simultaneous and staggered. Thus, permanent departure of fledglings, whether nestmates or not, from the home territory appears to be quite variable, with a 40-day range between all departures, and a 31-day range between departures of nestmates.

Movement of Fledglings Outside of the Home Territory

Eight of the nine radio-tagged fledglings, and three color-marked, untagged fledglings were located at least once away from the home territory. A total of 23 movements away from the home territory were recorded; these are given in Table 3. In 91.3% of these movements, the direction traveled was south, west, east, and a combination of these three directions. Only 8.7% of the movements involved a northerly direction.

Of these 23 recorded movements, 17 of them included the return of fledglings back to the home territory. Movements out where the fledglings later returned were generally of two patterns. Eighty-nine percent of the movements out were of short duration, where the fledgling returned either on the same day or within two days. These movements (88.9% of the total) ranged from 1.6 to over 8 kilometers (1 to over 5 miles) and averaged 3.06 kilometers (1.9 miles). The second type of movement out (11.1% of the total movements) was of longer duration, five to seven days. Distances traveled from the home territory were 28.4 and 35.4 kilometers (17 and 22 miles) in the two cases observed. The two fledglings involved in these two longer movements out from the home territory were older than when either they or the other radio-tagged young made shorter movements out.

The amount of movement out from and back to the home territory was variable for the nine radio-tagged young. Three young did not leave once until they left permanently. Three other young left and returned once before leaving permanently. Three remaining young left and returned four, four, and five times

Table 3. Description of movements of young out of the home territory, including age in days after fledging when they left, and the direction and maximum distance traveled from the home territory. Unradioed young which were occasionally observed away from the home territory are included.

Young	Age left	Direction and distance	Age returned	Age left	Direction and distance	Age returned	Age left	Direction and distance	Age returned	Age left	Direction and distance	Age returned	Age left	Direction and distance	Age returned	Age left
r34	35	SW 1mi(1.6)	36	38	SW 1mi(1.6)	39	39	SW 1mi(1.6)	40	45	SW 1mi(1.6)	45	49	SW 1mi(1.6)	49	51*
r11^{b}	34	SE,SW 1.5mi(2.4)	34	36	NW 4.5mi(7.2)	36	37	NW 4.5mi(7.2)	*	40	S <5mi(<8)	40	42	*		
r7^{o}	26	SE 2mi(3.2)	27	51	SW 1.2mi(1.9)	52	55	SW 1.2mi(1.9)	56	57	S,SW 17mi(27)	61	*			
r61^{o}	59	S,SE 22mi(35)	66	70	SE MIG											
r62	51	MIG														
r33	32	S 1mi(1.6)	33	34	SE MIG											
r61^{g}	39	S 0.5mi(0.8)	*													
r9	28	*	29	31	*											
r7^{b}	40	E 4mi(6.4)	*													
11^{o}	39	SE 3.5mi(5.6)	39													
7^{nc}	28	SE 2mi(3.2)	29													
11	53	SW 3.4mi(5.5)	*													

r = radio-tagged
mi = miles; kilometers in ()
* = bird lost, unless it later returned to the home territory
MIG = bird migrated out of the Gallatin Valley

before leaving permanently. The magnitude of movements out from and back to the home territory did not appear to be related to the length of time the young remained within the home territory and associated with the adults. The young that left and returned the greatest number of times, five, remained home the same number of days that a second young did, and this second young never left the home territory once, until it left permanently. Both young were home until 51 days after fledging. Another young remained home until 59 days after fledging without leaving.

Considering only the three radio-tagged young which remained associated with the adults in the home territory for 42, 51, and 61 days after fledging (and left and returned four, five, and four times, respectively), two of them had a tendency to return to the same area outside of the home territory again and again. The third young traveled mostly to different areas each time.

The three radio-tagged young which were followed up to their migration out of the valley migrated at 34, 51, and 70 days after fledging. Thus the age for migration appears to be variable. These young also had different degrees of experience away from the home territory—from zero to seven days away. These three young all made direct migrations from the valley, leaving both the home territory and the Gallatin Valley on the same day. This is probably not the case with all young. Three young, two radio-tagged and one just color-marked, were observed still only several miles from the home territory two days after leaving there permanently. Also, groups of from five to seven fledged Red-tailed Hawks have been observed hunting together for several days, within the valley. Apparently some fledglings leave the home territory permanently, but remain within the valley for an unknown period of time before migrating.

Acknowledgments

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SPATIO–TEMPORAL RELATIONSHIPS BETWEEN BREEDING RED-TAILED HAWKS AND GREAT HORNED OWLS IN SOUTH DAKOTA

by
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ABSTRACT. Twenty pairs of Red-tailed Hawks and Great Horned Owls which nested at five areas in Clay County, South Dakota, were studied from 1966 to 1971. Great Horned Owl breeding activities were about three weeks earlier than those of Red-tailed Hawks. Great Horned Owls used 17 old Red-tailed Hawk nests, one artificial nest, and on two occasions the same nest twice. Red-tailed Hawks built 19 new nests and one artificial nest. Active Red-tailed Hawk and Great Horned Owl nests when both species were present at the same site were at a distance of 290 to 4,360 feet (88-1329 meters) and averaged 2,070 feet (631 meters). Both species fledged young on 20 occasions.

Studies of intra- and interspecific spatio-temporal relationships between Red-tailed Hawks (*Buteo jamaicensis*) and Great Horned Owls (*Bubo virginianus*) are few. Nest site selection was studied by Baumgartner (1938, 1939), Craighead and Craighead (1956), Hagar (1957), and Smith (1969). Courtship, nesting activities and territoriality were studied by Baumgartner (1939) and Orians and Kuhlman (1956). These authors noted some spatio-temporal relationships between Red-tailed Hawks and Great Horned Owls, but no long-term data were given.

In this paper we present additional data about time and space relationships between Red-tailed Hawks and Great Horned Owls over a six-year period and comment on the use of man-made nests by raptors.

Materials and Methods

The breeding biology of Great Horned Owls and Red-tailed Hawks in Clay County, South Dakota, was studied from 1966 to 1971. During these years, at five general areas, 20 pairs each of Red-tailed Hawks and Great Horned Owls

*This paper was presented at the Conference on Raptor Conservation Techniques in Fort Collins, Colorado, 22-24 March 1973.

nested in close association in scattered woodlots and gallery forests. The data reported only refer to seasons when both species were present. Data on nest location, occupancy, egg laying, and reproductive success were gathered by direct observation. One artificial nest (24 inches (61 cm) square) made from chicken wire with grass and sticks interwoven to form the sides and bottom, was placed at the location of a broken Red-tailed Hawk nest.

Results and Discussion

Great Horned Owls initiated breeding prior to Red-tailed Hawks. The owls laid eggs around 10 February (earliest 28 January; latest 4 March) (Figure 1). Nestlings hatched about 20 March and fledged about 1 May. Achievement of independence and dispersal of young from the parental territories was not complete until December or January.

Red-tailed Hawks began courtship in mid-February and initiated nest building or repair about 27 February (Figure 1). Eggs were laid between 10 and 20 March and hatched about 15 April. Nestlings left their nests for the first time in early June and dispersed from the parental territories in late September and October. Adults of both species remained close to the nest sites all year.

Great Horned Owls fledged and seldom returned to the nest. Red-tailed Hawks "branched" and utilized the nests for feeding. They remained close to

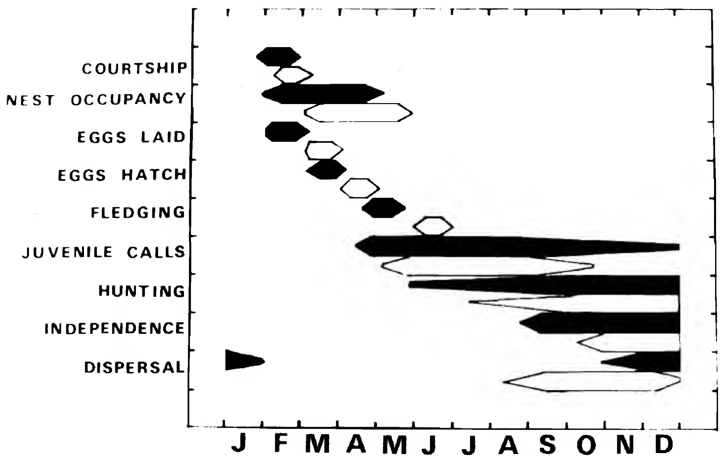

Figure 1. Chronology of annual events of breeding Great Horned Owls (filled bars) and Red-tailed Hawks (open bars) in South Dakota.

their nests for six to eight weeks after fledging. Adult and fledgling Great Horned Owls roosted in the canopy during the day for about two weeks after fledging and thereafter roosted on the ground. Red-tailed Hawks used the upper and mid-canopy for both daily activities and night roosting throughout the summer.

Red-tailed Hawks nested in mature cottonwood (*Populus sargentii* L.) and ash (*Fraxinus* sp.) trees. Nests were built in the middle or upper canopy of the taller trees and averaged 63 feet (19.2 meters, range 42 to 81 feet, 12.8 to 24.7 meters) above the ground. Great Horned Owls commonly nested in old Red-tailed Hawk nests. None built their own nests. Great Horned Owl preference for Red-tailed Hawk nests has been mentioned by Baumgartner (1938), Errington (1932) and Orians and Kuhlman (1956). Red-tailed Hawks built 19 new nests on 20 occasions. On two occasions the previous year's nest was available, but was not used. A pair once used an artificial nest. Great Horned Owls occupied 17 different old Red-tailed Hawk nests out of 20 nestings. Two pairs of owls used nests for two years in succession. Another pair used the artificial nest mentioned above—the same year it was built!

The spatial relationships between 20 active Red-tailed Hawk and Great Horned Owl nests at five locations are shown in Figures 2-6. Distances between nests were from 290 to 4,360 feet (Table 1) and averaged 2,070 feet (88-1329 meters, average 631 meters).

At these five areas when both species were present, 20 nests of each were successful with average productivity of 2.35 young per nest of Red-tailed Hawk and 2.05 young per nest of Great Horned Owl. Since these areas were selected for the presence of both species these figures do not represent the productivity in the region. In contrast to these observations are the findings of Craighead and Craighead (1956) who had no cases of Red-tailed Hawks and Great Horned Owls successfully fledging young when nesting closely. They credit Great Horned Owls with destroying Red-tailed Hawk nests. Smith (1969) found an active

Table 1. Distances between active Red-tailed Hawk nests and Great Horned Owl nests in five areas in South Dakota in feet (meters in parentheses).

Year	Area No. 4	Area No. 5	Area No. 6	Area No. 7	Area No. 16
1970	2,280	1,230	4,290	450	3,700
	(695)	(375)	(1308)	(137)	(1128)
1969	2,640	480	4,360	450	3,700
	(805)	(146)	(1329)	(137)	(1128)
1968	2,530	2,090	4,290	290	3,700
	(771)	(637)	(1308)	(88)	(1128)
1967		870		590	2,100
		(265)		(180)	(640)
1966		700		500	
		(213)		(152)	

Red-tailed Hawk nest on a ledge within 25 yards of an active Great Horned Owl nest in a cave and both nests failed and were abandoned during the incubation period. The senior author saw two adult Red-tailed Hawks stoop on and strike two different fledgling Great Horned Owls that were chased up from day roosts and flew across open fields but both owls survived.

Artificial Nest Use.—In the fall of 1969 one artificial nest was placed at the exact site of a broken Red-tailed Hawk nest built in 1968 and used and destroyed by Great Horned Owls in the spring of 1969 (Dunstan 1970). In 1970 Red-tailed Hawks fledged three young from this nest and in 1971 Great Horned Owls fledged two young from it.

Artificial platform nests can be used to attract certain species of raptorial birds to specific locations as has been shown for Ospreys (*Pandion haliaetus*) (Rhodes, 1972). We suggest that artificial nests can be used to increase productivity by placing them in locations that minimize conflicts with antagonistic species, including man. Artificial nests also provide strong nesting sites for spe-

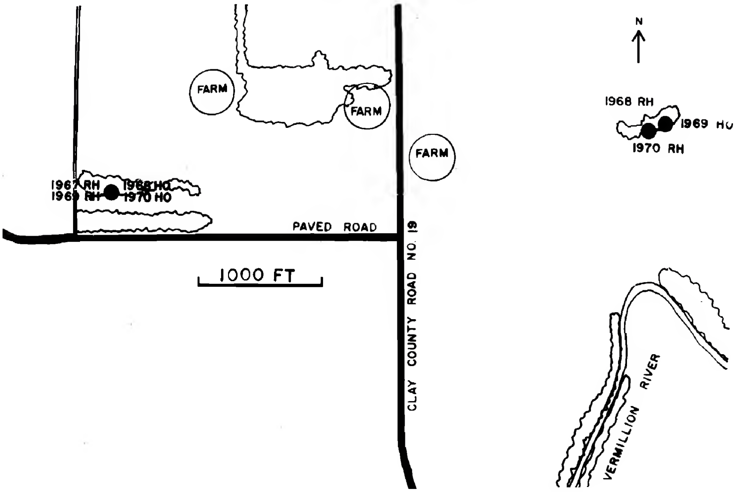

Figure 2. Area 4, 1967-1970, corn fields.

Figures 2-6. Great Horned Owl—Red-tailed Hawk nest site selection. Woods are outlined and surrounded by fields.

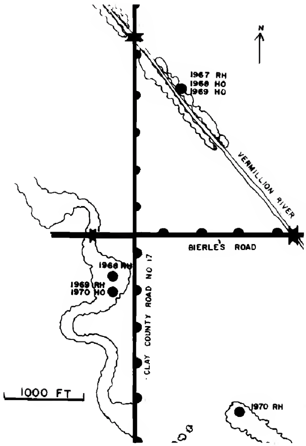

Fig. 3. Area 5, 1967-1970; corn fields and pasture west.

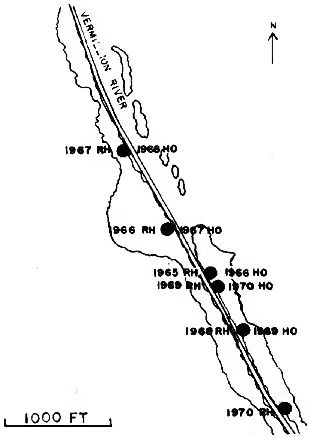

Fig. 4. Area 6, 1967-1970; corn fields.

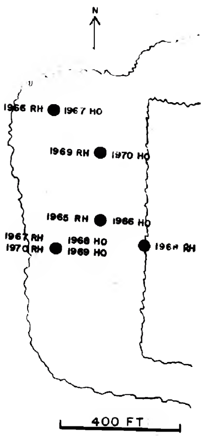

Fig. 5. Area 7, 1965-1970, alfalfa fields.

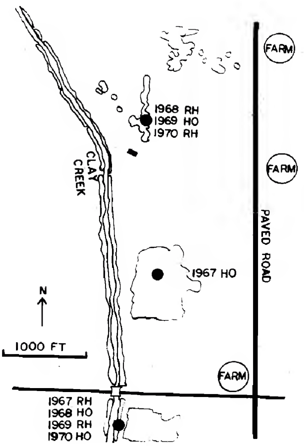

Fig. 6. Area 16, 1967-1970; corn field west of creek, pasture and alfalfa east.

cies such as owls that do not build or repair nests. In states like Minnesota where there are numerous all-terrain vehicles (300,000 snowmobiles were present in 1973) being operated during the egg laying and incubation period for Great Horned Owls and Bald Eagles (*Haliaeetus leucocephalus*), one could use artificial nests to attract breeding birds away from openings and edges such as fields and lake shores that are most often used by snowmobile operators. Dunstan and Borth (1970) showed that even Bald Eagles will tolerate artificial nests to some extent. Whether or not one can attract breeding eagles to new locations has yet to be proven.

Acknowledgments

The authors wish to express appreciation for financial assistance from the Biology Department of the University of South Dakota. Additional financial support given to the senior author from the Frank M. Chapman Memorial Fund of The American Museum of Natural History was gratefully appreciated. Mary Borkuis aided in preparation of the figures.

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REPORT:

PROCEEDINGS OF THE CONFERENCE ON RAPTOR CONSERVATION TECHNIQUES, FORT COLLINS, COLORADO, 22-24 MARCH, 1973

Part 1. INTRODUCTION

by Byron E. Harrell

The Raptor Research Foundation along with the Department of Fishery and Wildlife Biology of Colorado State University and the Colorado Division of Wildlife sponsored the conference held at the Student Center on the University campus. Dr. Richard R. Olendorff organized the program and Dr. Gustav Swanson was in charge of local arrangements. The Colorado Division of Wildlife hosted a social hour. The following served as chairmen of the various sessions: Leslie Brown, Tom J. Cade, James H. Enderson, Richard R. Fyfe, David Graham, Frederick H. Hamerstrom, Jr., Pershing B. Hofslund, Joseph R. Murphy, Richard R. Olendorff, Gustav Swanson, and Clayton M. White. A booklet including the program and abstracts of the papers presented was provided to participants.

The proceedings of the conference are being published in separate parts. The abstracts of papers not printed and edited informal discussion are included. The parts include:

1. Introduction, *Raptor Research* 7(2):55-61, 1973.
2. Raptor Ecology Sessions, *Raptor Research* 7(2):25-54, 62-69, 1973.
3. Management of Raptors, *Raptor Research Report,* No. 2, in press.
4. Raptor Research Techniques, *Raptor Research* 7(3/4):in press.
5. Rehabilitation and Pathology, *Raptor Research* 8(1):in press.
6. Population Status of Raptors, *Raptor Research Report,* No. 3, in press.

In the following list of papers on the program an asterisk (*) indicates the author presenting the paper.

Thursday Morning, March 22–Raptor Ecology

1. Is heart rate a good measure of the energy metabolism of the semi-free-living Kestrel? James A. Gessaman.
2. The energetics of size dimorphism. J. A. Mosher.
3. Differential habitat use by sexes of American Kestrels wintering in northern California. James R. Koplin.
4. Habitat and time utilization of nesting Sharp-shinned Hawks–a telemetry study. Joseph B. Platt.
5. Post-fledging activity of Red-tailed Hawks. Sara Jane Johnson.
6. Predatory efficiency of American Kestrels wintering in northwestern California. Michael W. Collopy.
7. Foraging behavior of Ospreys in northwestern California. Meyer L. Ueoka.

Thursday Afternoon, March 22–Raptor Populations–1

8. Population status of certain African raptors. Leslie H. Brown.
9. A study of nesting habits and reproductive success of Goshawks in Interior Alaska. Jerry D. McGowan.
10. Current status of the Peregrine Falcon in North America. Tom J. Cade.
11. Population status of the Peregrine Falcon in the Rocky Mountain States. James H. Enderson.
12. The Peregrine Falcon decline in California. III. The contributing causes. R. W. Risebrough, S. G. Herman*, M. N. Kirven, May Davey and Vernon Davey [paper not presented].
13. Changes in the Peregrine population at Langara Island, B.C. R. Wayne Nelson.
14. Status of Peregrines on Amchitka Island with remarks on the west-central Aleutians in general. Clayton M. White.
15. Summary of the west Greenland Peregrine Falcon survey–1972. William G. Mattox and William Burnham*.
16. Autumn emigrations of Peregrine Falcons on Assateague Island, 1970-72. Robert B. Berry and F. Prescott Ward.
17. South Padre Island: Recent years. Ralph R. Rogers* and W. Grainger Hunt.
18. Population status of Gyrfalcons in Alaska. L. G. Swartz*, W. D. Walker, D. G. Roseneau and A. M. Springer.

Thursday Evening, March 22–Raptor Populations–2

19. Population status of the Mississippi Kite. Babette F. Cranson.
20. Populations of the Mississippi Kite in the Great Plains. James W. Parker.
21. Reproductive success of Red-tailed Hawks in the Gallatin Valley, Montana. Sara Jane Johnson.
22. Population trends and breeding success of raptors in northeastern Ohio. David Howard and Roger Thacker*.

Thursday Evening, March 22–Rehabilitation and Pathology

23. Current work on raptor diseases in Kenya, East Africa. J. E. Cooper [read by David Graham].
24. Rehabilitation and release of injured and orphaned predatory birds. James Wisecarver.
25. Raptor rehabilitation. Roger Thacker.
26. Raptor rehabilitation and conservation in Minnesota. Mark R. Fuller*, Patrick T. Redig* and Gary E. Duck.
27. A rapid-acting injectable anesthetic for raptors. J. E. Cooper and Laurence Frank*.
28. A report on the use of a pectoral muscle biopsy in the field for organochlorine analysis. Laurence Frank* and J. E. Cooper.

Conference photos. Upper left, a portion of the audience. Upper right, Richard W. Fyfe. Lower right, Leslie Brown. Lower left, Tom Cade.

29. A Discussion of current pathological findings relevant to raptorial birds. David Graham.

Friday Morning, March 23–Raptor Populations–3

30. Populations and toxic chemical residues in western Canadian Prairie Falcons and Merlins. Richard W. Fyfe.
31. Nesting density and reproductive success of Prairie Falcons in southwestern Idaho. Verland T. Ogden.
32. Population status of five species of large raptors in northeastern Colorado. Richard R. Olendorff.
33. Population status of the Ferruginous Hawk in southeastern Idaho and northern Utah. Leon R. Powers*, Richard Howard, and Charles H. Trost.
34. The problems of Golden Eagles in the West. Walter R. Spofford [abstract presented by Leslie Brown with additional introductory comments].
35. Trends of Golden Eagle numbers in the western United States. Leo G. Heugly.
36. Status of a nesting Golden Eagle population in central Utah. Joseph R. Murphy.
37. Effects of organochlorines and mercury on southwestern Idaho Golden Eagles. Michael N. Kochert.

Friday Afternoon, March 23–Raptor Populations–4

38. The eagle survey in Wyoming. L. Warren Higby.
39. Golden Eagle-domestic sheep interaction in Utah. Leo G. Heugly.
40. Patterns of Bald Eagle productivity in northwestern Ontario, 1966-72. James W. Grier [read by Tom J. Cade].
41. A population study of Saskatchewan and Manitoba Bald Eagles. D. W. A. Whitfield, Jon M. Gerrard*, W. J. Maher and D. W. Davis.
42. Biology of Bald Eagles on Amchitka Island, Alaska. Steve K. Sherrod* and Clayton M. White.
43. Population status of the Osprey in northern Idaho and northeastern Washington–1972. Wayne E. Melquist* and Donald R. Johnson.
44. Effects of organochlorines on the American Kestrel. Jeffrey L. Lincer [paper not presented].
44a. Spatial and temporal relationships between Red-tailed Hawks and Great Horned Owls. Thomas C. Dunstan.

Friday Afternoon, March 23–Laws, Conservation and Total Protection

45. The law and North American raptors. Frank M. Bond.
46. The harvesting factor. J. Richard Hilton [read by Dave Siddon].
47. Conservation of birds of prey. Walter R. Spofford [paper not presented].

Friday Evening, March 23—Raptor Management—1

48. Artificial nesting platforms for Ospreys in Michigan. Sergej Postupalsky* and Stephen M. Stackpole [includes "Osprey", a movie produced by Conservation for Survival, Inc., 55 South Deeplands Dr., Grosse Pointe Shores, Michigan 48236, showing work done with Ospreys in Michigan, including the artificial platform project].
49. The problem of electrocution of eagles on powerlines. Morlan Nelson [includes a movie showing problems with powerlines in the west and natural history-type documentary on the Golden Eagle].

Saturday Morning, March 24—Raptor Management—2

50. An introduction to the concept of raptor management. Frances Hamerstrom.
51. Data requirements for raptor management programs. Leslie H. Brown.
52. Raptor management in Canada. Richard W. Fyfe.
53. A plan for managing the survival of the Peregrine Falcon in the 1970's. Tom J. Cade.
54. The potential for management of raptor populations in western grasslands. Richard R. Olendorff.
55. An approach to improve raptor management in Colorado. Gerald Craig.
56. Raptor management techniques in southeastern Colorado. William C. Andersen.
57. Conservation and management applications of biotelemetry studies from Cedar Creek Natural History Area. Mark R. Fuller*, J. R. Tester and T. H. Nicholls.

Saturday Afternoon, March 24—Raptor Management—3

58. The Bureau of Land Management and raptor management in Idaho. Michael N. Kochert.
59. The Snake River Birds of Prey Natural Area. Verland T. Ogden.
60. Powerline standards to reduce raptor losses on the Natural Resource Lands. John Crawford, A. Dunkeson, and Larry A. Dunkeson.
61. The BLM Habitat Management Technical Note Series for Endangered Species. Carol Snow.
62. Osprey management on the Lassen National Forest, California. David P. Garber*, J. R. Koplin and J. R. Kahl.
63. A National Park Service study of reintroduction techniques applicable to Golden Eagles. Steven B. Layman.
64. Suggested future research toward effective raptor management. Richard R. Olendorff* and John W. Stoddart, Jr.

Saturday Evening, March 24—Raptor Research Techniques

65. Field techniques in a study of the behavior of Peregrine Falcons. R. Wayne Nelson.
66. Advantages and disadvantages in the use of rotary-winged aircraft for raptor research. Clayton M. White* and Steve K. Sherrod.
67. Time-lapse photography: Its usefulness in studying nesting raptors. James H. Enderson.
68. Application of radio-telemetric techniques to studies of strigiform and falconiform birds. Thomas C. Dunstan.
69. An automated radio tracking system for biotelemetry. Mark R. Fuller* and John R. Tester.
70. A telemetering egg for use in studies of incubation and nesting behavior. David H. Ellis.
71. Evaluation of a vinyl wing marker for raptors. Michael N. Kochert.
72. A color-marking technique for permanently dyeing raptor feathers. Cathy H. Ellis.
73. Studies of reproductive success in raptors: Some problems with criteria and terminology. Sergej Postupalsky.

In addition to the formal program there were several special topic informal meetings:

1. Accipiter workers' discussion; Joseph B. Platt in charge (March 22).
2. Raptor disease discussion; David Graham in charge (March 24).
3. Rehabilitation discussion (March 24).
4. Telemetry equipment demonstration; arranged by RRF Bio-telemetry Committee (March 24).
5. Federal raptor regulations; questions answered by Alan Studholme (March 24).

Unscheduled motion pictures included some on Peregrine behavior by Richard W. Fyfe and on nesting of Great Gray Owl by R. D. Muir.

Persons in attendance are listed below according to state or country.

Kenya: Barbara Brown, Leslie Brown.

Canada: David M. Bird, Richard Fyfe, David Hughes, Paul Lague, R. D. Muir, R. Wayne Nelson, Mrs. R. W. Nelson.

Alaska: Jerry D. McGowan, L. Gerald Swartz.

California: David R. Brinkley, Robert Coleman, Michael Collopy, Jim B. Cranmer, Fidele de la Torre, Laurence Frank, David P. Garber, Jim Henrikson, Lee Henrikson, James Koplin, Hans J. Peeters, J. David Siddon, Judy Siddon, Meyer L. Ueoka, Jim Wisecarver.

Colorado: William C. Andersen, Paul H. Baldwin, Harold Boeker, Robert F. Buttery, Gerald R. Craig, Babette F. Cranson, John Crawford, Philip Creighton, Lawrence Crowley, James H. Enderson, Marilyn Ernest, Truman Fergin, Kenneth Feller, Robert B. Finley, Jr., John W. Flavin, Michael L. Furcolow, Charles Gibson, Sally Goddard, Giles Greenfield, Alan Harmata, Bill

Hobaugh, Dan Johnson, David Kirkland, C. Eugene Knoder, Rick Krasa, John McPartlin, Ken Mesch, David T. Moran, Carol Snow, John Squires, Mary H. Squires, Robert D. Squires, Jack Stoddart, Gustav Swanson, Robert K. Turner, Dale Wills, Bruce R. Wolhuter.

Florida: Thomas L. Richards.

Idaho: Tracy Fleming, Donald R. Johnson, Michael Kochert, Wayne E. Melquist, Morlan Nelson, Verland Ogden, Mrs. V. Ogden, Roger Olson, Leon R. Powers, Frank B. Renn, Charles H. Schwartz, Charles Trost.

Illinois: Tom Dunstan, Maria Dunstan, Richard J. Peirson.

Iowa: David L. Graham.

Kansas: Richard H. Barnes, Tom A. Buchanen, Ernest Nickens, James W. Parker.

Maryland: Donald A. Spencer.

Michigan: Stanley A. Marcus.

Minnesota: Mark Roy Fuller, Jon Gerrard, Nikki Higgins, Pershing Hofslund, Patrick Redig.

Missouri: Jeffrey C. Peters, Judith M. Southern.

Montana: John Baglien, Derek Craighead, Catherine Ellis, David Ellis, Joel Gustafson, Peter Jenny, Sara Jane Johnson, Bob Macdonald, John Mortenson, Bruce Nelson, Tom Nelson, Jon Swenson, Vincent Yannone.

Nebraska: Dale Becker, Jim Hurt, Ross Lock, William C. Russell.

New Jersey: Ed Henckel, Anita Maehlum, Carl Moritz, Teddy Schubert.

New Mexico: Frank M. Bond, Philip L. Shultz, James Stuart.

New York: Tom J. Cade, Bruce Hamilton, David Zimmerman.

Ohio: Jim Keener, Roger Thacker, James W. Wolfe.

Oklahoma: Mike Brewer, Frank M. Enhard.

Oregon: Ralph Anderson, 15 members of Portland Zoological Society.

Pennsylvania: Robert B. Berry, Rodney C. Gehrlein.

South Dakota: Leonard J. Bingham, John D. Forester, Wallace Russ Gorrell, Byron E. Harrell, Joyce Harrell, Gervaise Hittle, Donald V. Hunter, Dan O'Brien, B. J. Rose, Susan Sindt.

Texas: W. G. Hunt, Ralph R. Rogers, John C. Smith.

Utah: Alan Beske, Bill Burnham, Mayo W. Call, Steven R. Chindgren, Donald G. Donahoo, James A. Gessaman, Steve Hennessy, Leo G. Heugly, Rich Howard, M. Alan Jenkins, John Kimball, Donald P. Kyker, Jr., Carl D. Marti, James A. Mosher, Joseph R. Murphy, Don Paul, Joseph Platt, Gerald L. Richards, Scott W. Sawby, Steve Sherrod, Earl Sparks, Philip Wagner, Clayton M. White, Neil D. Woofinden.

Virginia: Stephen B. Freligh, Timothy A. McGreer, Brian Millsap, Allan Studholme.

Washington: Richard E. Fitzner, Kathy Layman, Stephan Layman, Richard R. Olendorff.

Wisconsin: Rodney N. Crouse, David Evans, David C. Frede, Frances Hamerstrom, Frederick Hamerstrom, E. Janiece Jensen, Sergej Postupalsky, Greg Septon, Charles Sindelar.

Wyoming: L. Warren Higby, Paul Jersky.

REPORT:

PROCEEDINGS OF THE CONFERENCE ON RAPTOR CONSERVATION TECHNIQUES, FORT COLLINS, COLORADO, 22-24 MARCH, 1973

Part 2. RAPTOR ECOLOGY SESSION

edited by
Byron E. Harrell

The opening session of the Conference on Thursday morning, 22 March, 1973 consisted of seven papers and was chaired by Dr. Gustav Swanson. An eighth paper in this area was inadvertently omitted from the program and was given the following day. Five of the eight papers were completed for publication in this issue of *Raptor Research.* Abstracts of the other papers are included below. The following papers on Raptor Ecology were presented.

1. *Gessaman, James A.,* Dept. of Zoology, Utah State University, Logan, Utah 84322.

Is Heart Rate a Good Measure of the Energy Metabolism of Semi-free-living Kestrel?

ABSTRACT. The ECG of Kestrels (*Falco sparverius*) was transmitted by telemetry to a receiver at distances of up to 250 feet. Two electrodes were surgically implanted in each bird and connected to an ECG transmitter harnessed on the bird's back. Carbon dioxide production and heart rate (measured by counting the R spikes on the ECG) of Kestrels resting in a small chamber at 10 different temperatures and of Kestrels during flight in a wind tunnel were measured. Subsequently the birds were released inside a large quonset building, and their heart rates were monitored for five seconds of every minute during each 24-hour period. Total daily CO_2 production of each of six birds was estimated for four days from the heart rate of each in conjunction with a CO_2-heart rate regression for each individual. Total daily CO_2 production was simultaneously estimated by a totally independent technique, the doubly-labeled water ($D_2O + H_2{}^{18}O$) method. A comparison of the results of these two methods suggests that the total daily CO_2 production of a Kestrel can be estimated from its heart rate with an error of less than 25%.

2. *Mosher, J. A.,* 1160 E. 230 S., Provo, Utah 84601.

The Energetics of Size-dimorphism.

ABSTRACT. The relationship between size-dimorphism and energetics of the Broad-winged Hawk was examined. The resting metabolic rate (RMR) of three

male and four female Broad-wings was measured over 20-30 days using food balance calorimetry. There was no significant difference between male and female per gram metabolic rates. It was concluded that a dimorphic pair of Broad-wings has an energetics advantage over a hypothetical monomorphic pair, proportional to the degree of the dimorphism. A model describing the relationship between size-dimorphism and the energy savings due to dimorphism is presented.

3. *Koplin, James R.,* School of Natural Resources, California State University, Humboldt, Arcata, California 95521.
Differential Habitat Use by Sexes of American Kestrels Wintering in Northern California [published in *Raptor Research* 7(2):39-42, 1973].

4. *Platt, Joseph B.,* Dept. of Zoology, Brigham Young University, Provo, Utah 84601.
Habitat and Time Utilization of Nesting Sharp-shinned Hawks—A Telemetry Study.

ABSTRACT. Data will be presented concerning a telemetry study of Sharp-shinned Hawks (*Accipiter striatus*). A pair of nesting adults was outfitted with radio transmitters and monitored from the time their eggs hatched until their young dispersed from the area 47 days later. The young were also tracked from fledging to dispersal.

The boundaries of the territory were determined. Within these boundaries were eight distinct communities; the utilization of these types by the birds will be discussed. Changes in the activity patterns and habitat utilization as the season progressed will be presented. Differences in time budgets of the male and female will be examined. Prey selection and the various foraging strategies employed by the raptors will also be presented.

5. *Sara Jane Johnson,* Dept. of Zoology and Entomology, Montana State University, Bozeman, Montana 59715.
The Post-fledging Period of the Red-tailed Hawk [published in *Raptor Research* 7(2):39-44, 1973].

6. *Michael W. Collopy,* School of Natural Resources, California State University, Humboldt, Arcata, California 95521.
Predatory Efficiency of American Kestrels Wintering in Northwestern California [published in *Raptor Research* 7(2):25-31, 1973].

7. *Meyer L. Ueoka,* School of Natural Resources, California State University, Humboldt, Arcata, California 95521.
Foraging Behavior of Ospreys in Northwestern California [published in *Raptor Research* 7(2):32-38, 1973 with James R. Koplin as junior author].

44a. *Thomas C. Dunstan,* Dept. of Biological Sciences, Western Illinois University, Macomb, Illinois 61455.
Spatial and Temporal Relationships between Breeding Red-tailed Hawks and Great Horned Owls in South Dakota [published in *Raptor Research* 7(2):49-54, 1973, with Byron E. Harrell as junior author and a slightly changed title].

The following transcription of the Raptor Ecology Session discussion period was edited for clarity and removal of redundancy and irrelevancy and was reorganized in sequence.

Sharp-shinned Hawk

JERRY McGOWAN: I'd like to ask Mr. Platt a question. After you have just observed young Sharp-shins to have made their first flight from the nest, did you find them returning to the nest tree to roost or for other activities, and if so, for how long, or for how many days, did they continue to do this?

JOSEPH PLATT: I was able to move right underneath the nest area in the grove and just quietly sit there. I had a young perch near me; the female preened just a few feet away. So I think I was observing normal behavior, and they did not pay any attention to the nest *per se.* They had a very regular place of perching. It was on the north end of the grove where they could see the adults coming back easier. But there was no affinity for the nest at all.

DAVID ELLIS: I'd like to ask what method you used for triangulating the bird; did you actually locate the bird in a certain point on the map?

PLATT: For observation, I'd go into the study area when I knew where they were going and wait and track them coming in. It was a fairly visible area. The growth was low and open. The road provided me fast access up and down. I could get a mile away and triangulate myself with some accuracy; otherwise visual observations over the 45 days put it all together.

GLEN WOOFINDEN: Have you heard any special procedures in trying to find the nests of your Sharp-shinned or Cooper's Hawks by mating behavior or any special observation?

PLATT: There are a whole lot of things in the wind and I think that if you would join with us in the accipiter discussion, other people have a lot better methods than I can give you.

Red-tailed Hawk

BRUCE WOLHUTER: I want to address a question to Miss Johnson. You seem to have an unusually high density of Red-tails. Then you mentioned a number of nests that didn't make it. Do you have any idea why you had such a high number that didn't make it, or that you said had problems?

SARA JANE JOHNSON: I think it must be that 60% of the birds that begin nesting are successful, so it's about 40% failure. That's during incubation up to maybe the first week after hatching. I think that the amount of failure after the birds start nesting is a little lower than the average in other areas.

MORLAN NELSON: Did you observe adults running the young ones out of the area? Did you ever see any aggression of the adults forcing the young to move out?

JOHNSON: No, not driving thesyoung out of their territory. The adults always recognize their own young, even one that had been there 70 days after fledging. He had been gone a week and he came back and there was no antagonism at all. There was some aggression at times when the young would hassle the adults for food–you know, keep chasing them from perch to perch. But that is the only form of aggression–just doing food hassles–not driving them out of the territory.

STEVEN CHINDGREN: What do you attribute to the cause of Red-tails which you said didn't make it?

JOHNSON: As for the cause, I don't know. It's pretty normal, I think the average is. I'm giving another paper on the reproduction in which I'll give the figures. It's from about 20% to 40% failure before hatching in all populations. Mine is a little bit higher than most, but this seems to be normal.

CHINDGREN: Do you attribute this to desertion of the egg or to infertile eggs?

JOHNSON: I did not climb any of the nests for my nesting study until after the young had hatched, so this wouldn't be a factor in the failure. I don't know if it was desertion or if they just failed to lay eggs or if they deserted after they laid.

GILES GREENFIELD. In connection with the nesting failures, I noticed on one chart two nests in consecutive years produced the same number of young. I wonder whether the parents were the same. Did you identify that?

JOHNSON. No, I had no accurate idea if they were the same adults both years or not.

GREENFIELD. I also notice the similarity of the same two nesting areas each year and I wondered, in view of failure elsewhere, whether they had the same parents?

JOHNSON: It could be that the adults are permanently paired; if they are and if these are older adults, they are probably more successful, and if they maintain the same territory they probably do have a higher success rate than other territories. But I'm sure that while the nests that were lost (some of them after the young had hatched), were due to predation, so this would also be a factor which really wouldn't be related to territories so much or the birds' nesting.

KENNETH MESCH: In non-productive nests did you find adults defending that nest site? Or could these be alternate nest sites in other years?

JOHNSON: I think in close to 70 nests that produced young over the two years, I had two where the adults were defending the nests and after I climbed them there was nothing there, no eggs, or anything. I assume that maybe they were juveniles and that this was their first nesting attempt. But they did defend the nest partly through the summer without even laying eggs.

MESCH: What I'm talking about is that map that you had of productive and non-productive Red-tails. Was this non-productive nest site defended by adults?

JOHNSON: No.

MESCH: Oh, they weren't. How did you know that these were active at all?

JOHNSON: Well, they failed after they started the nesting attempt.

MESCH: Then there were adults there.

JOHNSON: Well, I checked the nests starting when they returned. They came back by the first of March and immediately set up territories and started building nests. This is when I first checked and then I came back about a month later, actually after I figured that the eggs had hatched, and then I started checking. These are then the ones that aren't defended; they are the ones that have failed.

American Kestrel

JOHN BAGLIEN: A question for Mike Collopy here. Considering the prey selection and relative importance of various species of prey on the diet; do you have any data that consider the relative differences in biomass available as food, comparing the rodents to the grasshoppers or other insects?

MICHAEL COLLOPY: No, that is something that is going to be considered. That's going to be done in conjunction with the metabolic studies that I plan on carrying on next fall. But just speculating a bit I'm sure there's more than one reason why there is the increase in rodents taken in the winter. I feel there are quite a lot fewer insects if any at all has an effect, but at the same time in the winter the metabolic rates are a great deal higher when it's cooler than in the summer, and they would have to catch twice or three times as many insects. I'm sure it would be much more expensive metabolically speaking than capturing three or four shrews or meadow voles during the day. But this is something that's going to be worked out. I'm sure it's very important.

PATRICK REDIG: Did you notice at any time the Kestrel making any attempt to stash food or stores?

COLLOPY: I've seen probably close to 25 different attempts. We've recorded all these and I plan to try to publish them this spring.

WOLHUTER: My experience with Kestrels has been in Kansas and Colorado and certainly we have quite a different climate during the winter season. Could you give us an idea of what your temperature extremes, high and low, would be for the winter months? You seemed to think it rather significant that you had that switch to the vertebrates that we would expect in our area. Did you expect this is unusual for your area or is this more the normal thing?

JAMES KOPLIN: May I answer that? The temperature fluctuates between normally let's say, 35 degrees to 50 degrees during the winter months; occasionally we get frost. But during the month of December we had a very cold low trough extending down into Humboldt–well, actually throughout California–which wiped out nearly all of our eucalyptus, for example, throughout the Bay area. In that part of the country it was severe; water lines froze up, it was an extremely cold time for California, the coldest on record for Arcata and the Bay area. Normally I would say we have a pretty substantial invertebrate prey population level, but not this particular year.

Osprey

JON SWENSON: I have a question for Mr. Ueoka. You say that the Ospreys nested along streams. Do you mean that these streams supported productive fisheries that could supply food for the Osprey? And if so, were those populations exploited?

MEYER UEOKA: They did take salmon in Elk River and other streams that they nested along. But through my observations I've never seen Ospreys fish these other streams. The fish that I could identify on delivery at nests were surf perch, and others that are found in the bay and not in the streams.

KOPLIN: At the risk of being boring could I answer that question? Osprey nest along the Eel River to quite a large extent and they do fish the Eel River. The birds that Meyer worked with nest inland from three to five miles. Just why we don't really know because there are suitable nest sites along the coast. Our assumption is that the combination of off-shore summer winds and fogs may limit their nesting activities to further inland. And they quite commonly have to fly three to five miles to the bay that day and fly back. The streams that his nests are on are so small that we doubt very seriously if they could catch any fish in them. They're generally empty or with no fish found in them during the summer months when the birds are there. In support of this idea, we've not seen any of the birds fish the streams. I've sat on Elk River road during the summer months for example and watched Ospreys fly toward the bay from the nesting area and fly back and give every appearance of not paying the least bit of attention to the streams. But they do feed on the streams on the Klamath River and on the Eel River.

SERGEJ POSTUPALSKY: Do you have any data on the depths in which the Osprey were fishing? In other words, were they in relatively shallow water or deep water?

UEOKA: The area on the slide that I showed looking toward the mud flat is usually covered with water during high tide, and that's where most of the fishing activities took place: during high tide and in the channel in low tide.

POSTUPALSKY: How much water is there? Just a few feet?

UEOKA: Yes, about three or four feet.

MELSTAD: Do you have recorded any period of activity by time of day; is there more activity in the morning or in the afternoon?

UEOKA: Yes, I did, and activity was heaviest from 12 noon until about 4:00 or 5:00 in the afternoon.

JOHN SMITH: Along this same line did you find that the birds collected or attempted to fish harder as the young became larger or did they possibly waste more food as the young were smaller and utilize less efficient fishing?

UEOKA: I saw more fishing activity during the brooding period; right off I can't give you the numbers on that. There was more activity observed at that time.

KOPLIN: I can answer that question. We measured these rates of food delivery at Osprey nests in Montana and Dave Graber did the same thing in California. As the young aged and grew in weight, the rate and quantity of food delivery increased in direct proportion to the size of the young.

SMITH: The size of prey, did that increase too?

KOPLIN: It seemed to be a situation where one particular nest pair would select prey of about the same size and another nest would select slightly larger prey. The upshot of the whole thing was they tended to deliver more prey of the same size at a given nest.

PUBLICATION NOTICE:
NEW PUBLICATIONS FROM BRIGHAM YOUNG UNIVERSITY

Two important papers have been published recently in the *Brigham Young University Science Bulletin, Biological Series.* They can be obtained from University Press Marketing, Brigham Young University, Provo, Utah 84602. Descriptions and the authors' abstracts follow.

Smith, D. G., and J. R. Murphy. 1973. Breeding ecology of raptors in the eastern Great Basin of Utah. *Brigham Young Univ. Sci. Bull., Biol. Ser.* 18(3): 1-76, June, 1973. 8"x10½". 27 figures and 39 tables. Paper covers. Price $2.00.

A comparative study of the breeding ecology of 12 raptor species was conducted in the eastern Great Basin from 1967-1970. The project was designed to determine the composition and densities, habitat selection, territoriality and predatory habits of raptorial birds in a semi-arid environment. All topics were analyzed comparatively, relating the requirements and activities of the 12 raptor species.

Average yearly population densities of all species approximated 0.5 pairs per square mile, but much of the available habitat was not utilized. Predominant raptors were the Ferruginous Hawk and Great Horned Owl. Other important raptors included the Golden Eagle, Red-tailed Hawk and Raven.

The breeding activities of the collective raptor populations occurred over a period of eight months. Great Horned Owls and Golden Eagles were the first raptors to initiate nesting activities, usually in late January and early February. The raptor breeding season terminated with the fledging of the young Cooper's Hawks and Burrowing Owls in late August.

The fecundity of the raptor populations varied between years. Specific causes of mortality of eggs and young included nest desertion and destruction, predation, apparent egg infertility, and accidents, most of which could be directly attributed to some form of human interference.

The observed home ranges of the raptor species were a function of their body size and breeding status.

The food of the raptors included at least 55 different prey species, but most relied heavily on only one or two species. A correlation between raptor size and mean prey weight was evident. No examples of raptor predation on game or domestic livestock were found.

Porter, R. D., and C. M. White. 1973. The Peregrine Falcon in Utah, emphasizing ecology and competition with the Prairie Falcon. *Brigham Young Univ. Sci. Bull., Biol. Ser.* 18(1):1-74, June, 1973. 8"x10½". 46 figures and 11 tables. Paper covers. Price $2.00.

This study was undertaken to record the known history of the Peregrine Falcon (*Falco peregrinus*) in Utah as we have been able to construct it from both the literature and from our original research that extends over about a 30-year period in the state. The present total population of the Peregrine in Utah is possibly only 10% of what it has been in historic times. In an effort to find explanations for the decline, we have explored hypotheses of climatic changes, impact of pesticides, disease and human disturbances. We conclude that pesticide contamination and climatic changes may have been the major reasons for their decline in Utah.

A general background of the geographical and ecological distribution of the species in Utah is provided as are also details of its nesting behavior from some Wasatch Mountain eyries. Our data suggest that its nesting density along the Wasatch Mountains was about the same order of magnitude as nesting densities in other regions of North America that are generally considered more favorable to the Peregrine.

We have considered some of the environmental factors that may limit the species in Utah and especially its relationship with a congener, the Prairie Falcon (*Falco mexicanus*). We conclude that the Peregrine may live jointly with the Prairie Falcon with a minimum of intraspecific competition. We present evidence which suggests that the Peregrine has been in Utah since the late Pleistocene and that it has had a long history of sympatric existence with the Prairie Falcon.

NOTES, NEWS, AND QUERIES

Publication Date of Spring Issue, 1973. Volume 7, Number 1, Spring 1973 of *Raptor Research* was published April 9, 1974. Mailing was over a period of weeks since the membership billing was included in the first class mailing.

New Membership Mailing Address. We are happy to announce that Mr. Edward S. Freienmuth has taken over the membership and publication order files of the Foundation; all membership questions and orders should be addressed to him, RRF Membership Services, Route 3, Box 301, Durango, CO 81301.

Publication of Raptor Research Abstracts. After many delays Volume 1, Numbers 1 and 2, Spring and Summer 1973, of *Raptor Research Abstracts* was published on April 13, 1974. There is an extended description of the search and abstract preparation methods for the use of cooperators and for the user's understanding of the material. We hope to expand the numbers of cooperators and the scope of the coverage.

Raptor Telemetry Research Survey Report. The Bio-Telemetry Committee of RRF has prepared a 47-page report which has been issued as "Raptor Telemetry Information Exchange" No. 1. This report and later numbers of RTIE are available for $1.00 from RRF Membership Services. The RTIE is set up like the BPIE as an informal information exchange and is not to be considered as a formal publication.

Breeding Project Information Exchange. The BPIE is now operated by the Laboratory of Ornithology, Cornell University, 159 Sapsucker Woods Road, Ithaca, NY 14850, as a service for the Raptor Research Foundation, under the direction of Dr. Tom Cade, Chairman of the RRF Captive Breeding Committee. The subscription of $3.00 should be sent directly to BPIE, Cornell Laboratory of Ornithology.

Veterinary Aspects of Captive Birds of Prey. A book with this title, 112 pages and 16 plates by J. E. Cooper, B.V.Sc., M.R.C.V.S., D.T.V.M., has been published by the Hawk Trust. The author, a member of the RRF Raptor Pathology Committee, covers comprehensively the recognition and treatment of raptor diseases. Because of limited numbers orders should be addressed promptly to: Hon. Sec. The Hawk Trust, Newent, Gloucestershire, England. Prices are: Case Bound in green cloth £5.00, Loose sheets £3.50; both packing and postage extra letter post 55p, parcel post 25p, airmail Europe 90p, airmail overseas £1.70.

THE RAPTOR RESEARCH FOUNDATION, INC. is a non-profit corporation whose purpose is to stimulate, coordinate, direct and conduct research in the biology and management of birds of prey, and to promote a better public understanding and appreciation of the value of these birds.

A major activity is publication. The quarterly *Raptor Research* prints research, reports, reviews, comments and news notes. The quarterly *Raptor Research Abstracts* summarizes and indexes literature on these birds. Longer papers or collections of papers are in *Raptor Research Report.*

Another important activity is the sponsoring of conferences. There have been three Captivity Breeding Conferences. The Conference on Raptor Conservation Techniques in March 1973 provided a very extensive review of current raptor research. The Proceedings will appear in issues of *Raptor Research* and *Raptor Research Report.*

Systems of information exchange on specialized areas have been initiated. Ninety "Breeding Project Information Exchange (BPIE) have appeared so far (available by subscription of $3 sent to BPIE, Laboratory of Ornithology, Cornell University, 159 Sapsucker Woods Road, Ithaca, NY 19850). A new project, "Raptor Telemetry Information Exchange" (RTIE), begins with a research survey report (subscription $1 from RRF). Additional special area information exchanges are anticipated soon.

Another active area has been the Pathology Committee. This group of professional veterinarians and others deals with the special health problems of raptors. They have conducted autopsies, treated ill birds, and provided consultation information as well as providing valuable information at several of our conferences.

MEMBERSHIP

Membership in the Raptor Research Foundation is open to all who contribute. *Raptor Research* is sent to all who contribute a minimum of $6.00 per year; those who wish to receive both *Raptor Research* and *Raptor Research Abstracts* contribute an additional $4.00. Memberships should be sent to: Edward S. Freienmuth, RRF Membership Services, Box 301, Durango, CO 81301.

PUBLICATIONS

All previous publications are still available from RRF Membership Services.

Raptor Research News, 1967-1969, Vols. 1-3, 4 issues each, $2.00/vol.; 1970-1971, Vols. 4-5, 6 issues each, $3.00/vol.

Raptor Research, 1972-1973, Vols. 6-7, 4 issues each, $4.00/vol. Supplement to Vol. 6, $2.00.

Raptor Research Abstracts, Vol. 1, 1973, 4 issues, $2.00.

Raptor Research Report

No. 1. Richard R. Olendorff, "Falconiform Reproduction; A Review. Part 1. The Pre-nestling Period." February 1971, 111 pp., $2.50 ($2.00 to members).

No. 2. Management of Raptors (Proc. Rapt. Cons. Tech. Part 4) in press, $5.00 ($4.00 to members).

No. 3. Population Status of Raptors (Proc. Rapt. Cons. Tech. Part 5) in press. $6.25 (members $5.00).